

## The millipede family Paradoxosomatidae in Paraguay, with descriptions of five new species (Diplopoda, Polydesmida)

Sergei I. GOLOVATCH

Institute for Problems of Ecology and Evolution, Russian Academy of Sciences, Leninsky pr. 33, Moscow 119071 (V-71), Russia. E-mail: sgol@orc.ru

**The millipede family Paradoxosomatidae in Paraguay, with descriptions of five new species (Diplopoda, Polydesmida).** - A review is provided of the millipede family Paradoxosomatidae in Paraguay, with keys compiled to 14 genera and 63 species occurring in this country and/or adjacent areas. Five species are described as new: *Catharosoma bilineatum* sp. n., *C. mahnerti* sp. n., *Broelemannopus minutus* sp. n., *Mestosoma simplex* sp. n. and *M. crassipes* sp. n.

**Keywords:** Diplopoda - Polydesmida - Paradoxosomatidae - taxonomy - Paraguay.

### INTRODUCTION

The family Paradoxosomatidae is among the largest among the Diplopoda, with nearly 200 genera currently accepted as valid. The American fauna is highly peculiar due to the absence of indigenous paradoxosomatids north of Costa Rica. In South America two major centres of diversification are distinguishable, one in the area of southern Brazil, Paraguay and northern Argentina, the other in Peru, northern Bolivia and possibly Ecuador. The vast regions of northern Brazil, Guiana, Venezuela and Colombia appear to harbour very few species (Jeekel, 1968, 2002).

The Neotropical fauna itself is strongly dominated by relatively few (about a dozen) genera of the endemic tribe Catharosomatini. Of these genera, *Mestosoma* Silvestri, 1897 is certainly the largest and particularly widespread, with about 75 species occurring throughout South America and reaching both Costa Rica and the island of Dominica (introduced?) in the north. *Catharosoma* Silvestri, 1913 is the second largest genus, its 13 species being known from Brazil, Paraguay and Argentina (Hoffman, 1980, 1999). The remaining genera are mono- to oligotypic.

The present paper provides a review of, and keys to, the bulk of the paradoxosomatids occurring in the southern Neotropical diversification centre, based both on all available literature sources and on the important collection of Paradoxosomatidae from Paraguay housed in the Muséum d'histoire naturelle, Geneva (MHNG). Five new species from three genera of Catharosomatini have been revealed there, all described below and thus considerably enriching our knowledge of the fauna of Paraguay. A few paratypes from the material have been retained for the collection of the Zoological Museum, State University of Moscow (ZMUM), Russia.

## FAUNISTIC REVIEW

Since detailed reviews of the history of research on Neotropical Paradoxosomatidae are available and still fully relevant (Jeekel, 1963, 1968), only a short account appears necessary here concerning the species list of the particular region involved. Virtually all later contributions (e.g. Hoffman, 1977, 1999; Golovatch, 1992; Jeekel, 2002; Golovatch *et al.*, 2003) are irrelevant in the present context, as they only or chiefly treat more northern faunas.

The following Paradoxosomatidae from Paraguay and/or the adjacent parts of Bolivia, northern Argentina and southern Brazil have hitherto been recognized as valid:

***Broelemannopus* Verhoeff, 1938**

*Broelemannopus escaramucensis* (Schubart, 1944) - Brazil (São Paulo) (Schubart, 1944, 1952)

*B. glabratus* (Schubart, 1945) - Brazil (Rio de Janeiro) (Schubart, 1945b)

*B. ibitiensis* (Schubart, 1945) - Brazil (São Paulo) (Schubart, 1945a)

*B. pirassunungensis* (Schubart, 1944) - Brazil (São Paulo) (Schubart, 1944, 1945a, 1952)

***Catharosoma* Silvestri, 1897**

*Catharosoma curitibense* Schubart, 1953 - Brazil (Paraná) (Schubart, 1953)

*C. digitale* Schubart, 1953 - Brazil (Paraná) (Schubart, 1953)

*C. hoffmani* Kraus, 1956 - Paraguay (Kraus, 1956)

*C. intermedium* (Carl, 1902) - Brazil (Rio Grande do Sul) (Carl, 1902; Attems, 1914, 1937)

*C. mesorpinum* (Attems, 1898) - Brazil (Santa Catarina) (Attems, 1898, 1914, 1937; Schubart, 1953)

*C. mesoxanthum* (Attems, 1898) - Brazil (Santa Catarina) (Attems, 1898, 1914, 1937; Schubart, 1953)

*C. mixtum* Kraus, 1956 - Brazil (Santa Catarina) (Kraus, 1956)

*C. myrmekurum* (Attems, 1898) - Brazil (Santa Catarina) (Attems, 1898, 1914, 1937; Schubart, 1953)

*C. palmatum* Schubart, 1953 - Brazil (Paraná) (Schubart, 1953)

*C. palustre* Schubart, 1943 - Brazil (Mato Grosso) (Schubart, 1943)

*C. paraguayense* (Silvestri, 1895) - Paraguay, Argentina and Brazil (Santa Catarina and Mato Grosso) (Silvestri, 1895b, 1902; Attems, 1898, 1914, 1937; Schubart, 1953; Kraus, 1956; Jeekel, 1965) («South America», according to Mauriès, 1998)

*C. peraccae* Silvestri, 1902 - Paraguay (Silvestri, 1902; Attems, 1914, 1937)

*C. taeniatum* (Brolemann, 1929) - Brazil (Santa Catarina) (Brolemann, 1929; Attems, 1937; Schubart, 1953)

***Chondromorpha* Silvestri, 1897**

*Chondromorpha xanthotricha* (Attems, 1898) - pantropical, introduced (e.g. Jeekel, 1963)

***Gonodrepanoides* Schubart, 1945**

*Gonodrepanoides travassosi* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

***Gonodrepanum* Attems, 1914**

*Gonodrepanum drepanephoron* (Attems, 1898) - Brazil (São Paulo) and Argentina (Attems, 1898, 1901, 1914, 1937; Brölemann, 1902b; Mauriès, 1998)

*G. falciferum* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

*G. flavolineatum* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

*G. furcatum* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

*G. grajahuense* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

*G. levisetum* (Attems, 1898) - Brazil (Santa Catarina) (Attems, 1898, 1914, 1937; Schubart, 1953; Mauriès, 1998)

*G. levisetum* var. *coniferum* (Attems, 1898) - Brazil (Santa Catarina) (Attems, 1898, 1914, 1937; Schubart, 1953; Mauriès, 1998)

*G. torresae* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

***Habrodesmoides* Attems, 1943**

*Habrodesmoides costalimai* (Schubart, 1945) - Brazil (Rio de Janeiro) (Schubart, 1945b)

*H. perturbans* Attems, 1943 - Brazil (Rio de Janeiro) (Attems, 1943)

***Mestosoma* Silvestri, 1897**

*Mestosoma alticola* (Attems, 1931) - Bolivia (Cochabamba) and Peru (Attems, 1931, 1937; Kraus, 1956)

*M. balzanii* (Silvestri, 1895) - Bolivia (Yungas) (Silvestri, 1895a; Attems, 1914, 1937)

*M. bicolor* Silvestri, 1898 - Paraguay and Brazil (Mato Grosso) (Silvestri, 1898, 1902; Attems, 1899, 1914, 1937; Jeekel, 1965)

*M. boliviae* (Chamberlin, 1957) - Bolivia (near Potosí) (Chamberlin, 1957)

*M. borellii* (Silvestri, 1895) - Argentina (Tucuman) and Paraguay (Silvestri, 1895b; Attems, 1914, 1937; Mauriès, 1998)

*M. camerani* (Silvestri, 1895) - Argentina (Chaco) (Silvestri, 1895b; Attems, 1914, 1937; Jeekel, 1965; Mauriès, 1998)

*M. carioca* (Schubart, 1945) - Brazil (Rio de Janeiro) (Schubart, 1945b)

*M. derelictum* (Silvestri, 1895) - Bolivia (Misiones Mosetenes) (Silvestri, 1895a; Attems, 1914, 1937)

*M. differens* Kraus, 1956 - Bolivia (Cochabamba) (Kraus, 1956)

*M. femorale* (Schubart, 1943) - Brazil (Mato Grosso) (Schubart, 1943)

*M. kalliston* (Attems, 1898) - Brazil (Rio Grande do Sul) (Attems, 1898, 1914, 1937)

*M. luctuosum* Silvestri, 1897 - Bolivia (Caiza) (Silvestri, 1897; Attems, 1914, 1937)

*M. lugubre* Silvestri, 1897 - Argentina (Buenos Aires) and Uruguay (Silvestri, 1897, 1902; Attems, 1914, 1937; Mauriès, 1998)

*M. montanum* (Silvestri, 1895) - Bolivia (Yungas) (Silvestri, 1895a; Attems, 1914, 1937)

*M. perfidum* (Schubart, 1943) - Brazil (São Paulo) (Schubart, 1943)

*M. pseudomorphum* (Silvestri, 1895) - Paraguay (Silvestri, 1895b; Carl, 1902; Attems, 1914, 1937; Jeekel, 1965)

*M. pulvillatum* (Attems, 1898) - Paraguay (Attems, 1898, 1901, 1914, 1937)

*M. salvadorii* (Silvestri, 1895) - Argentina (Salta), Bolivia (Chaco) and Paraguay (Silvestri, 1895b, 1902; Attems, 1914, 1937; Hoffman, 1977; also Costa Rica, according to Mauriès, 1998)

*M. schindleri* Kraus, 1956 - Bolivia (Silhuencas) (Kraus, 1956)

*M. tricuspis* (Verhoeff, 1938) - Paraguay (Verhoeff, 1938)

*M. truncatum* (Schubart, 1943) - Brazil (Mato Grosso) (Schubart, 1943)

*M. vittatum* (Attems, 1898) - Paraguay (Attems, 1898, 1914, 1937)

***Mogyella*** Schubart, 1944

*Mogyella nana* Schubart, 1944 - Brazil (São Paulo) (Schubart, 1944, 1952)

***Mogyosoma*** Schubart, 1944

*Mogyosoma hamatum* Schubart, 1944 - Brazil (São Paulo) (Schubart, 1944)

***Ologonosoma*** Silvestri, 1898

*Ologonosoma iguassuense* (Schubart, 1953) - Brazil (Paraná) (Schubart, 1953; Mauriès, 1998)

*O. sanctum* (Silvestri, 1895) - Paraguay (Silvestri, 1895a; Attems, 1914, 1937; Mauriès, 1998)

***Orthomorpha*** Bollman, 1893

*Orthomorpha coarctata* (De Saussure, 1860) - pantropical, introduced (e.g. Jeekel, 1963)

***Oxidus*** Cook, 1911

*Oxidus gracilis* (C. L. Koch, 1847) - subcosmopolitan, introduced (e.g. Jeekel, 1963)

***Promestosoma*** Silvestri, 1898

*Promestosoma boggianii* Silvestri, 1898 - Paraguay (Silvestri, 1898; Attems, 1899, 1914, 1937; Jeekel, 1965; Mauriès, 1998) and Brazil (Mato Grosso and Mato Grosso do Sul) (original data)

***Pseudogonodrepanum*** Schubart, 1945

*Pseudogonodrepanum scitum* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)



A few more species, i.e. *Mestosoma laetum* Silvestri, 1897 (Bolivia, San Francisco – Silvestri, 1897), «*Strongylosoma*» *nitidum* Brölemann, 1902 (Brazil, Cubatão, São Paulo – Brölemann, 1902a), «*Strongylosoma*» *pustulatum* Brölemann, 1902 (Brazil, São Paulo – Brölemann, 1902b) and *Catharosoma bromelicola* Schubart, 1945 (Brazil, Rio de Janeiro – Schubart, 1945b), the male characters of which are not or are insufficiently known, still remain *incertae sedis*; none can be included in a key (Jeekel, 1963).

The same concerns *Iulidesmus* Silvestri, 1895, with its type-species *I. typicus* Silvestri, 1895 known only from a female holotype from Bolivia (Yungas) (Silvestri, 1895a). Jeekel (1963) correctly excluded *Iulidesmus* from Paradoxosomatidae on the basis of a later redescription of *I. typicus* from Chilean material provided by Silvestri (1905). But Hoffman (1980), rightly doubting the conspecificity of the Bolivian and Chilean samples, believes that the holotype of *I. typicus* represents a *Mestosoma*. If so, then *Mestosoma* becomes a junior synonym of *Iulidesmus*. Only topotypic material in connection with revisionary work can shed additional light on the identity of all of the enigmatic taxa mentioned above.

## DESCRIPTIONS OF NEW SPECIES

### *Catharosoma bilineatum* sp. n.

Figs 1-9

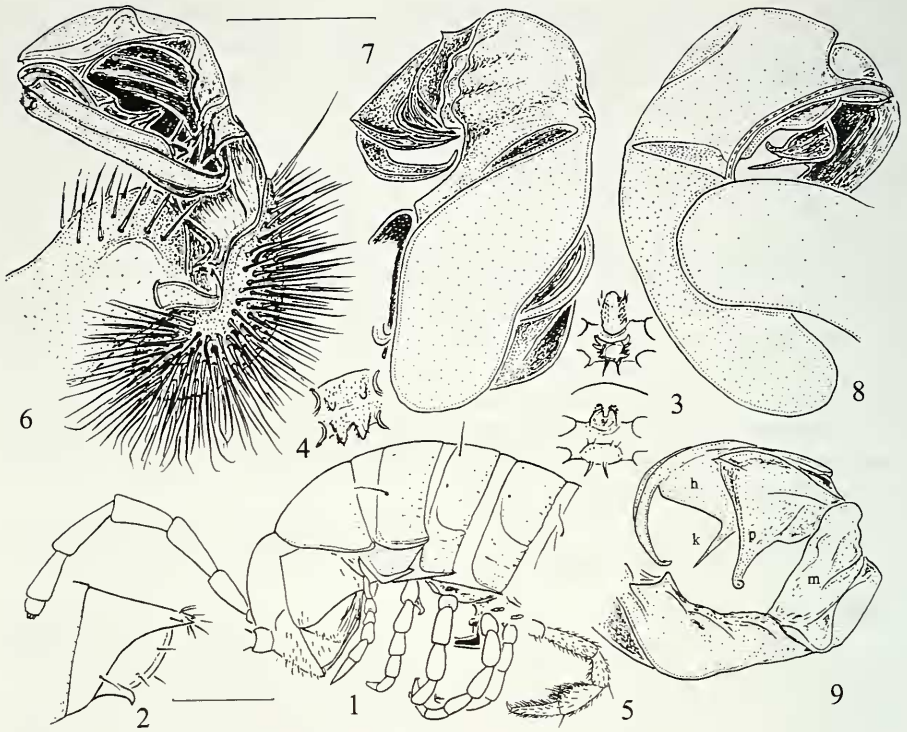
*Material*: Holotype ♂ (MHNG), Paraguay, Alto Paraná Prov., Forestry Centre (C.F.A.P.), Puerto Presidente Stroessner, plot 7, 18.03.1983, leg. P. Berner & C. Dlouhy. – Paratypes: 1 ♀ (MHNG), same locality, together with holotype; 1 ♂, 3 ♀♀ (MHNG), 1 ♂, 1 ♀ (ZMUM), same locality, around Pindo trunk, plot 3, 24.03.1983, leg. C. Dlouhy; 1 ♀ (MHNG), same locality, soil sample, plot 4 (Monte natural), Winkler extraction, 10.03.1983, leg. C. Dlouhy; 1 ♀ (MHNG), same plot 4 (Monte natural), 10.03.1983, leg. P. Berner & C. Dlouhy; 1 ♀ (MHNG), same locality, soil sample, plot 2 (Monte natural), 29.02.1983, leg. C. Dlouhy; 1 ♂ (MHNG), same locality, soil sample, plot 8 (Monte natural), 18.03.1983, leg. P. Berner & C. Dlouhy.

*Name*: To emphasize the presence of two dark paramedian stripes divided by a similarly wide but light axial stripe.

*Diagnosis*: Differs from congeners by the characteristic coloration, the strongly reduced paraterga visible only on segments 2-4, the presence of relatively short antennae, the deeply divided sternal lobe present between coxae 6 of the ♂, the subunciform tip of the hypoproct, the bifid tip of the epiproct, coupled with certain details of solenophore structure.

*Description*: Length 21-27 mm (♂, ♀), width of midbody metazona 1.9-2.1 (♂) or 2.1-2.8 mm (♀); ♀ usually larger and somewhat broader than ♂. Holotype *ca* 23 mm long and 2.0 mm wide. Coloration in alcohol pale yellowish brown to brown, with a characteristic pair of brown to dark brown paramedian stripes divided by an equally wide axial stripe of background coloration; legs and sterna yellowish gray, slightly paler than background coloration; tip of antennae pallid, penultimate antennomere dark brown; posterior half of body always somewhat paler than anterior one.

Body subcylindrical, not moniliform. Postcollar constriction faint, width of head = 5-16 > collum = 4 > 2 = 3; on segments 17-20 trunk gradually and gently tapering toward telson both in width and in height. Antennae relatively short, slightly clavate, *in situ* reaching beyond segment 2 dorsally (Fig. 1), a little shorter in ♀.



FIGS 1-9

*Catharosoma bilineatum* sp. n., ♂ holotype: 1) anterior body portion, lateral view; 2) telson, lateral view; 3) sternal structures between coxae 4-7 (coxae 4 on top); 4) sternal structures between midbody coxae; 5) leg 12; 6-9) left gonopod, medial, ventral, lateral and ventromedial views, respectively. Scale bars 1.0 (1-5) and 0.25 mm (6-9).

Paraterga strongly reduced, only on segment 2 fully developed as low keels with a caudal tooth, discernible on segments 3 and 4 as arcuated sulci (Fig. 1), on following segments totally missing. Tegument smooth, shining, only rear parts of metazona often faintly rugulose. Limbus thin, caudal margin entire. Metaterga fully devoid of a transverse sulcus; setae medium-sized, often abraded, arranged 2+2 in a transverse line behind a shallow stricture between pro- and metazona. Ozopores lateral, opening level to metatergal surface *ca* 1/3 metazonital length away from caudal edge. Pleurosternal carinae shaped like narrow keels with a caudal spinule (Fig. 1) traceable until segment 16 (♀) or 17 (♂), on following segments wanting. Epiproct (Fig. 2) rather long, coniform, bifid, in ♂ a little longer than in ♀. Hypoproct (Fig. 2) subtriangular, tip pointed, unciform, directed ventrad; 1+1 paramedian setae at caudal edge considerably separated from each other. Paraterga, pleurosternal carinae and hypoproct uncus in ♂ a little more strongly developed than in ♀.

Sterna densely setose. Sternum between coxae 3 of ♂ with a paramedian, nearly contiguous pair of bunches of setae. Sternum between coxae 4 of ♂ with a prominent, linguiform, laterally setose outgrowth directed anteroventrad (Fig. 3); a similar but

much lower outgrowth between coxae 5 of ♂ (Fig. 3); a more or less prominent and deeply divided outgrowth between coxae 6 of ♂ poorly delimited caudally against a similar but less prominent bulge with peculiar paramedian bunches of setae between coxae 7 of ♂ (Fig. 3). Postgonopodial sterna with shorter (between anterior coxae) or longer (between posterior coxae), coniform, paramedian spines developed a little better in ♂ (Fig. 4) than in ♀.

Legs without tarsal brushes but densely setose ventrally; setation gradually thinning out toward telson; tibiae swollen ventrally and supporting characteristic brushes (Fig. 5) between leg-pair 9 until two last pairs. Legs in ♂ a little longer than in ♀, as usual becoming a little longer and slenderer toward telson. Each coxa 2 of ♂ with a prominent, somewhat sinuate, distoventral spine carrying a gonopore at base.

Gonopods (Figs 6-9) highly complex. Coxite elongate, subcylindrical, setose distoventrally; cannula normal. Telopodite strongly unciform, with a hypertrophied, as usual densely setose prefemoral part somewhat longer than femorite. A few undulations on ventrocaudal face and a few longitudinal ridges anterodorsally at base of solenophore. Solenophore coiled, ventrally with both a slightly folded base of lamina medialis (**m**) and a subtriangular parabasol lobe (**p**) similarly well-developed; **p** followed by a spine (**k**) supporting the tip of a flagelliform solenomere at base of a hyaline lobule (**h**), this lobule supporting the penultimate 1/4 extent of both lamina lateralis and lamina medialis; distalmost 1/4 extent of both laminae slender, unciform, free of support.

*Remarks:* Judging from the colour pattern and gonopod structure, this new species seems to be especially close to *C. mesoxanthum*, but both differ in size, in structure of the process between coxae 6 of the ♂, and in direction of the apical papillae on the epiproct (see also key below).

### *Catharosoma mahnerti* sp. n.

Figs 10-17

*Material:* Holotype ♂ (MHNG), Paraguay, Prov. Concepción, Estancia Laguna Negra, 15 km E of Paso Barreto, dead wood, 13.10.1985, leg. Expédition zoologique du Muséum de Genève. – Paratypes: 1 ♂, 2 ♀♀ (MHNG), 1 ♂, 1 ♀ (ZMUM), same locality, together with holotype; 1 ♂ (MHNG), Prov. Concepción, near mouth of Ao River, Trementina (Estancia Laguna Negra), forest, 13.10.1985, leg. Expédition zoologique du Muséum de Genève.

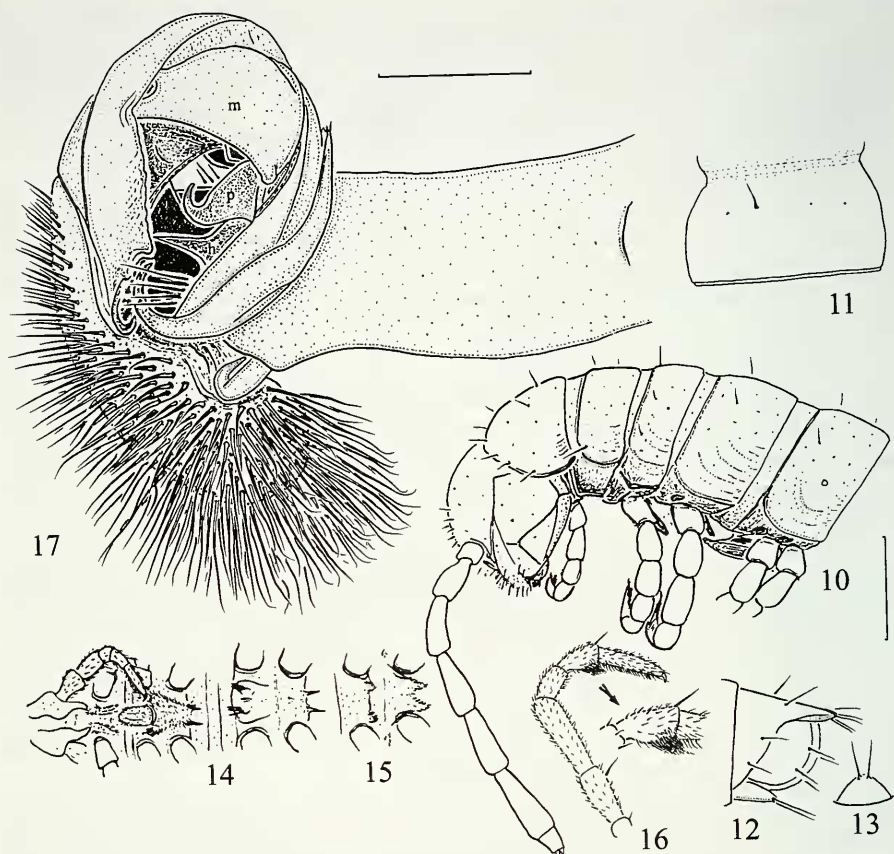
*Name:* Honours Dr Volker Mahnert, who entrusted me this valuable material for study.

*Diagnosis:* Differs from congeners by the submoniliform body, the longer antennae, the absence of a distinct colour pattern and of an unciform hypoproct, the presence of two paramedian pilose ridges between coxae 3 of the ♂, and in certain details of gonopod structure.

*Description:* Length 20-23 mm (♂, ♀), width of midbody metazona 1.7 (♂) to 2.3-2.5 mm (♀); ♀ usually larger and somewhat broader than ♂. Holotype *ca* 20 mm long and 1.7 mm wide. Coloration in alcohol uniformly light brown to red-brown; only penultimate antennomere rather dark brown, tip of antenna pallid; legs paler, yellow-brown to brown.

Body subcylindrical, submoniliform. Postcollar constriction faint, width of head = 5-16 > collum = 4 > 2 = 3; on segments 17-20 trunk gradually and gently tapering toward telson both in width and in height. Antennae medium-sized, slender, *in situ* reaching beyond segment 3 dorsally (Fig. 10), a little shorter in ♀. Paraterga





Figs 10-17

*Catharosoma mahnerti* sp. n., ♂ paratype: 10) anterior body portion, lateral view; 11) metatergum 10, dorsal view; 12) telson, lateral view; 13) hypoproct, ventral view; 14) sternal structures between coxae 2-7 (legs 2 at left); 15) sternal structures between midbody coxae; 16) leg 15; 17) right gonopod, medial view. Scale bars 1.0 (10-16) and 0.2 mm (17).

strongly reduced, only on segment 2 fully developed as low keels devoid of a caudal tooth, discernible on segments 3 and 4 as arcuated lines, on segment 5 as modest swellings (Fig. 10), on following segments totally missing. Tegument smooth, shining, only metazona at places faintly rugulose. Limbus thin, caudal margin entire. Metaterga fully devoid of a transverse sulcus; setae short, often abraded, arranged 3+3 on segments 2 and 3, on following segments 2+2 in a transverse line behind a rather deep stricture between pro- and metazona (Fig. 11). Ozopores lateral, opening level to metatergal surface *ca* 1/3 metazonital length away from caudal edge (Fig. 10). Pleurosternal carinae like narrow keels with a caudal spinule (Fig. 10) traceable until segment 16 (♀) or 17-18 (♂), onward wanting. Epiproct (Fig. 12) rather long, coniform, faintly emarginate at tip in dorsal view, in ♂ a little longer than in ♀. Hypoproct



(Figs 12, 13) subtriangular, tip narrowly rounded, nearly pointed, straight; 1+1 paramedian setae at caudal edge poorly separated. Paraterga, pleurosternal carinae and hypoproct a little more strongly developed in ♂ than in ♀.

Sternal structure (Figs 14, 15) much like in *C. bilineatum* sp. n., but with two paramedian pilose ridges between coxae 3 of ♂ and paramedian bunches of setae on poorly developed knobs between coxae 6 of ♂.

Legs without tarsal brushes but densely setose ventrally; setation gradually thinning out toward telson; tibiae swollen ventrally and supporting characteristic brushes (Fig. 16) between leg-pair 7 and two last pairs. Legs in ♂ a little longer than in ♀, as usual becoming a little longer and slenderer toward telson. Each coxa 2 of ♂ with a strong, distoventral, sigmoid, apically pointed process carrying a gonopore at base (Fig. 14).

Gonopods (Fig. 17) highly complex, much like in *C. bilineatum* n. sp., but coxite more elongate, telopodite circular and elongate, while solenophore ventrally with a much larger, hyaline lobe/base of lamina medialis (**m**), an apically strongly unciform parbasal lobe (**p**) followed by a spiniform process supporting a flagelliform solenomere at base of a hyaline lobule (**h**), this lobule supporting the penultimate  $1/4$  extent of both lamina lateralis and lamina medialis; distalmost  $1/4$  extent of both laminae likewise slender, unciform, free of support.

*Remarks:* Judging from the particularly elongate gonopod telopodite, which includes the femorite, this new species seems to be especially close to *C. curitibense* and *C. intermedium*, but the circular telopodite and the shape of its individual elements in *C. mahnerti* sp. n. are quite characteristic.

At first Jeekel (1963) merged *Catharosoma* and *Mestosoma* together, but later (1968) he separated them on the account of the apparently more apomorphic character states observed in *Mestosoma* species. This viewpoint has also been shared by Hoffman (1980).

### *Broelemannopus minutus* sp. n.

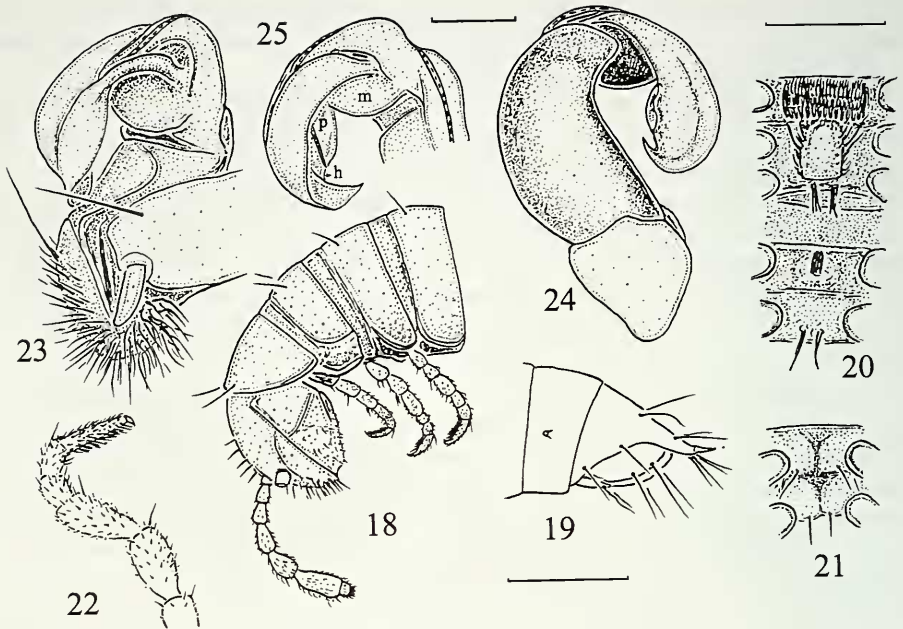
Figs 18-25

*Material:* Holotype ♂ (MHNG), Paraguay, Alto Paraná Prov., Forestry School, 12 km S of Puerto Presidente Stroessner, soil sample 1, 04.1983, leg. C. Dlouhy. – Paratypes: 20 ♂♂, 22 ♀♀, 2 juv. (MHNG), 2 ♂♂, 2 ♀♀ (ZMUM), same locality, together with holotype; 1 ♂, 1 ♀ (MHNG), same locality, soil sample 8, 04.1984; 2 ♂♂, 1 ♀ (MHNG), same locality, soil sample 24, 06.1984; 3 ♂♂ (MHNG), same locality, soil sample 10, 05.1984; 1 ♀, 3 juv. (MHNG), same locality, soil sample 22, 25.06.1984; 1 ♂, 1 ♀ (MHNG), same locality, soil sample 25, 25.06.1984; 1 ♂ (MHNG), same locality, soil sample 7, 04.1984; 1 ♂, 3 juv. (MHNG), same locality, soil sample 23, 25.06.1984; 2 ♂♂ (MHNG), same locality, soil sample 3, 21.05.1984; 1 ♂, 1 ♀, 1 juv. (MHNG), same locality, soil sample 13, 04.1984; 1 ♂, 1 ♀, 1 juv. (ZMUM), same locality, soil sample 30, 04.1984; 14 ♂♂, 17 ♀♀ (MHNG), same locality, soil sample 12, 04.06.1984, all leg. C. Dlouhy.

*Name:* To emphasize the small body size.

*Diagnosis:* Differs from congeners by the particularly small size, the especially strongly reduced paraterga visible only on segment 2, the lack of transverse metatergal sulci, the absence of a distinct colour pattern and of an unciform hypoproct, and in certain details of solenophore structure.

*Description:* Length 7-9 mm (♂, ♀), width of midbody metazona 0.6-0.7 (♂) to 0.8-0.9 mm (♀); ♀ usually larger and somewhat broader than ♂. Holotype *ca* 8 mm



FIGS 18-25

*Broelemannopus minutus* sp. n., ♂ paratype: 18) anterior body portion, lateral view; 19) caudal body portion, lateral view; 20) sternal structures between coxae 3-7 (coxae 3 on top); 21) sternal structures between midbody coxae; 22) leg 10; 23-25) right gonopod, medial, lateral and anterodorsal views, respectively. Scale bars 0.5 (18-19), 0.25 (20-22) and 0.1 mm (23-25).

long and 0.7 mm wide. Coloration in alcohol uniformly brown to red-brown, only juveniles, antennae and legs paler, yellow-brown to brown; tip of antenna pallid.

Body subcylindrical, not moniliform. Postcollar constriction faint, width of head > collum > 2 ≥ 3 < 4 < 5-16; on segments 17-20 trunk gradually and gently tapering toward telson both in width and in height. Antennae medium-sized, slender, *in situ* reaching the end of segment 2 dorsally (Fig. 18), a little shorter in ♀. Paraterga strongly reduced, only present as low lines devoid of a caudal tooth on segment 2 (Fig. 18), on following segments totally missing. Tegument smooth, shining. Limbus thin, caudal margin entire. Metaterga fully devoid of a transverse sulcus; setae relatively long, sometimes abraded, arranged 2+2 on segment 2, on following segments 1+1 in a transverse line behind a shallow stricture between pro- and metazona (Fig. 18). Ozopores lateral, opening level to metatergal surface *ca* 1/3 metazonital length away from caudal edge. Pleurosternal carinae like narrow arcuated lines (Fig. 18) traceable until segment 16 (♀) or 17 (♂), on following segments wanting. Epiproct (Fig. 19) rather long, coniform, in ♂ a little longer than in ♀, tip with a strong claw-shaped uncus directed dorsocaudally. Hypoproct (Fig. 19) subtriangular, tip narrowly rounded, nearly pointed, straight; 1+1 very long paramedian setae at caudal edge poorly separated from each other. Paraterga, pleurosternal carinae, epi- and hypoproct in ♂ a little more strongly developed than in ♀.

Sterna mostly sparsely setose. Sternum between coxae 3 of ♂ furnished with several transverse rows of relatively small, subcontiguous, scale-like structures on a boss (Fig. 20). Sterna between coxae 4 and 5 of ♂ with a very prominent, linguiform, laterally setose outgrowth directed anteroventrad (Fig. 20); a paramedian pair of bunches of setae between coxae 5 and 7 of ♂ (Fig. 20); a central, compact and thicker bunch of setae on a swelling between coxae 6 of ♂ (Fig. 20). Postgonopodial sterna without modifications (Fig. 21).

Legs without tarsal brushes but densely setose ventrally, without modifications (Fig. 22); setation gradually thinning out toward telson; legs in ♂ a little longer than in ♀, as usual becoming a little longer and slenderer toward telson. Each coxa 2 of ♂ nearly unmodified, with a small distoventral cone surmounted by a gonopore.

Gonopods (Figs 23-25) not particularly complex. Solenophore ventrally with a distinct but not hypertrophied, rounded, hyaline lobe/base of lamina medialis (**m**); another simple, parabaasal lobe (**p**) supporting the tip of a flagelliform solenomere at base of a smaller hyaline lobule (**h**), the latter supporting the subterminal part of both lamina lateralis and lamina medialis; distalmost extent of both laminae very short and rather broad, subunciform and subtruncate.

*Remarks:* Judging from the particularly small size, the similarly uncigerous epiproct, the paraterga present on segment 2 only, as well as from several other traits, including those of the gonopod, the new species seems to be especially close to *B. ibitiensis*, from Monte Alegre, São Paulo State, Brazil (Schubart, 1945a). The distinctions of *B. minutus* lie in the total absence of sternal cones on postgonopodial segments of the ♂, as well as the presence of a smaller and differently armed lobe between coxae 3 of the ♂, and of a smaller lobe **p** on the solenophore (see also key below). *B. ibitiensis* has only tentatively been placed in *Broelemannopus* (see Jeekel, 1963) but, since this species shows especially close affinities with *B. minutus* sp. n., there can no longer be any doubt that both are congeners best to be assigned to *Broelemannopus*.

In general the genus *Broelemannopus* is so poorly distinguished from *Mestosoma* that at first Jeekel (1963) merged these two genera together and treated the former as only a species group of the latter. However, later (1968) he separated them on the basis of certain apomorphies observed in both (see key below), a view which is also shared by Hoffman (1980).

### *Mestosoma simplex* sp. n.

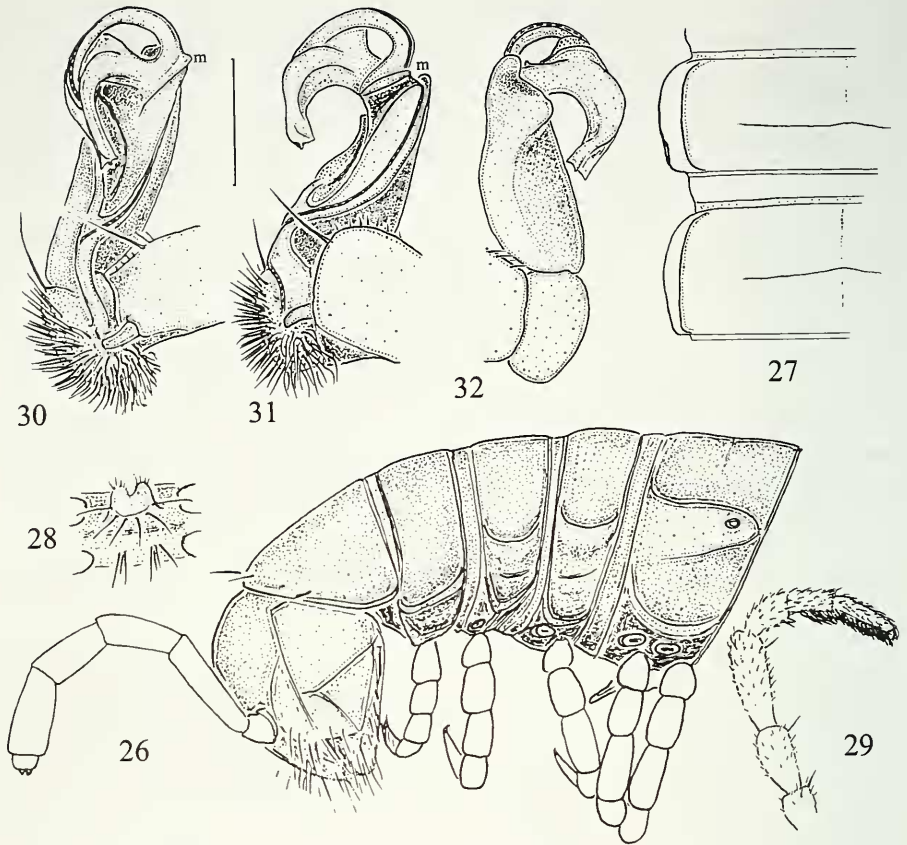
Figs 26-32

*Material:* Holotype ♂ (MHNG), Paraguay, Prov. Cordillera, 5 km N of Emboscada, Rio Piribebuy, forest with bromeliads, dead wood and leaves, 05.04.1985, leg. Expédition zoologique du Muséum de Genève. – Paratype: 1 juv. (MHNG), same locality, together with holotype.

*Name:* To emphasize the only slightly modified legs of the ♂ and the relatively simple gonopod structure.

*Diagnosis:* Differs from congeners by the relatively small size, the only slightly modified legs of the ♂, and the relatively simple solenophore structure.

*Description:* Length of holotype ca 12 mm, width of midbody metazona 1.5 mm. Coloration in alcohol uniformly light red-brown, anterior body portion



FIGS 26-32

*Mestosoma simplex* sp. n., ♂ holotype: 26) anterior body portion, lateral view; 27) left halves of segments 10 and 11, dorsal view; 28) sternal structures between coxae 4 and 5 (coxae 4 on top); 29) leg 15; 30-32) right gonopod, medial, submedial and lateral views, respectively. Scale bar 0.6 (26-29) and 0.3 mm (30-32).

slightly more intensely reddish; penultimate antennomere darker brown, tip of antenna pallid; legs paler, yellow-brown.

Body strongly somoid, not moniliform, with poorly developed but evident paraterga. Postcollar constriction apparent, width of head = collum  $> 2 = 4 \ll 5-16$ ; on segments 17-20 trunk gradually and gently tapering toward telson both in width and in height. Antennae medium-sized, slightly clavate, *in situ* reaching beyond segment 2 dorsally (Fig. 26), a little shorter in juvenile. Paraterga 2 and 5-19 delimited by an evident sulcus not only dorsally but also ventrocaudally (Fig. 26), all set low, considerably larger on pore-bearing segments than on poreless ones (Fig. 27), only on segments 18 and 19 slightly projecting beyond rear tergal contour. Tegument smooth and shining. Limbus thin, caudal margin entire. Metaterga 5-17 with a faint but



apparent transverse sulcus far from reaching base of paratergum, the sulcus being very slightly sinuate anteromedially; axial impression on metaterga interrupted in the middle, barely visible; tergal setae untraceable (Figs 26, 27). Stricture between pro- and metazona thin and shallow (Figs 26, 27). Ozopores lateral, lying on paraterga at  $ca\ 1/4$  metazonal length away from caudal edge (Figs 26, 27). Pleurosternal carinae like narrow keels delimited by a sulcus dorsally, devoid of a caudal spinule (Fig. 26), traceable until segment 17, on further segments wanting. Epiproct rather long, coniform, narrowly truncate at tip in dorsal view, in ♂ a little longer than in juvenile. Hypoproct roundly triangular, tip evidently rounded, straight; 1+1 paramedian setae at caudal edge rather strongly separated from each other.

Sterna modestly setose, mainly unmodified but both with an evident, deeply emarginate, setose, linguiform outgrowth directed anteroventrally between coxae 4 of ♂ and with a paramedian pair of bunches of setae between coxae 5 of ♂ (Fig. 28).

Legs only slightly modified, in ♂ with dense tarsal brushes starting from leg-pair 1 and with dense tibial brushes starting from leg-pair 2 (Fig. 29), both these brushes thinning out toward telson but absent only from last two leg-pairs. Each coxa 2 of ♂ with a low distoventral cone bearing a gonopore.

Gonopods (Figs 30-32) relatively simple. Coxite subcylindrical, not particularly elongate, sparsely setose distoventrally. Telopodite subfalcate, a densely setose prefemoral part normal in shape, much shorter than femorite. Solenophore unciform, somewhat constricted at base, relatively stout and simple; lobe **m** at base of both solenomere and lamina medialis highly inconspicuous, ledge-shaped, lamina lateralis slightly better developed than lamina medialis, tips of both subtruncate.

*Remarks:* Due to the basally strongly constricted solenophore, *M. simplex* sp. n. joins group III in the sense of Jeekel (1963), which has hitherto been known to comprise only three species, one each from the Brazilian states of Pernambuco, Alagoas and São Paulo. However, the new species differs in its smaller size, in the absence of femoral and some sternal modifications in the ♂, and in the particularly simple gonopod structure.

### *Mestosoma crassipes* sp. n.

Figs 33-42

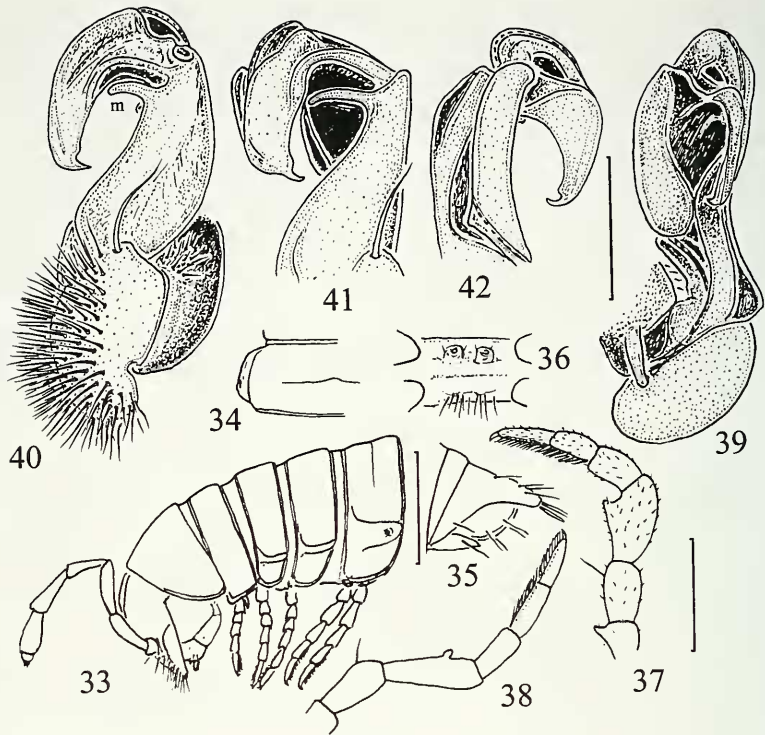
*Material:* Holotype ♂ (MHNG), Paraguay, Prov. Concepción, Ao. Tagatya-mi, small grove, near "gué", sifted litter, 23.10.1985, leg. Expédition zoologique du Muséum de Genève.

*Name:* To emphasize the modified and inflated legs of the ♂.

*Diagnosis:* Differs from congeners by the relatively small size, the conspicuously modified legs of the ♂, and by the relatively complex gonopod structure.

*Description:* Length of holotype  $ca\ 12$  mm, width of midbody metazona 1.3 mm. Coloration in alcohol uniformly light brown; antennae brown, penultimate antennomere darker brown; tip of antenna pallid; legs slightly paler.

Body strongly losomoid, not moniliform, much like in *M. simplex* sp. n. Post-collar constriction apparent, width of head ? collum =  $4 > 2 = 3 < 5 < 6(7)$ -16; on segments 17-20 trunk gradually and gently tapering toward telson both in width and in height. Antennae medium-sized, slightly clavate, *in situ* reaching beyond segment 2 dorsally (Fig. 33). All paraterga set low, delimited by an evident sulcus not only dorsally but also ventrally to ventrocaudally (Fig. 33), on segment 19 particularly flat



FIGS 33-42

*Mestosoma crassipes* sp. n., ♂ holotype: 33) anterior body portion, lateral view; 34) left half of metatergum 10, dorsal view; 35) caudal body portion, lateral view; 36) sternal structures between coxae 3 and 4 (coxae 3 on top); 37) leg 7; 38) leg 9; 39-42) left gonopod, submedial, sub-lateral, ventrolateral and anterodorsal views, respectively. Scale bars 1.0 (33-35), 0.5 (36-38) and 0.3 mm (39-42).

in lateral view, considerably larger on pore-bearing segments than on poreless ones (Figs 33, 34), never projecting beyond rear tergal contour. Tegument smooth and shining. Limbus thin, caudal margin entire. Metaterga 5-18 with a faint but apparent transverse sulcus far from reaching base of paratergum, the sulcus being slightly sinuate anteromedially; axial impression on metaterga wanting; tergal setae untraceable (Figs 33, 34). Stricture between pro- and metazona thin and shallow (Figs 33, 34). Ozopores lateral, lying on paraterga at  $ca \frac{1}{4}$  metazonal length away from caudal edge (Figs 33, 34). Pleurotergal carinae like narrow keels delimited by a sulcus dorsally, devoid of a caudal spinule (Fig. 33), traceable until segment 17, on following segments wanting. Epiproct rather long (Fig. 35), coniform, narrowly truncate at tip in dorsal view. Hypoproct triangular, tip pointed, straight; 1+1 paramedian setae at caudal edge widely separated from each other (Fig. 35).

Sterna mainly modestly setose, postgonopodial ones unmodified, pregonopodial ones with a paramedian pair of bunches of setae on small cones between coxae 3 and

4 of ♂ (Fig. 36); sterna between coxae 5-7 of ♂ concave and with some particularly long setae (like in Fig. 36).

Legs modified, with dense tarsal brushes starting from leg-pair 1 and with dense tibial brushes starting from leg-pair 2 (Figs 37, 38), both these brushes thinning out toward telson and virtually absent only from last two leg-pairs. Femora 4-6 conspicuously inflated and each with an evident distoventral tooth. Legs 7 (Fig. 37) with a distoventral cone on each coxa and a little less strongly incrassate femora, the tooth situated more ventro-apically. Femora 9-11 (Fig. 38) nearly normal, ventral knobs in distal one-third gradually disappearing toward leg-pair 12. Each coxa 2 with a low distoventral cone bearing a gonopore.

Gonopods (Figs 40-42) somewhat more complex than in the previous congener, especially so due to a longitudinal sulcus on dorsal face of femorite, a digitiform process (**m**), not a ledge-shaped structure lying at base of lamina lateralis, as well as a short, unciform and pointed solenophore tip.

*Remarks:* This new species seems to be particularly close to *M. alticola* and to a few other congeners possessing a small but evident process (**m**) at base of both the solenophore and solenomere (see Attems, 1937). The colour pattern in *M. crassipes* sp. n. resembles that of *M. femorale*, yet the gonopod structure is quite different (see Schubart, 1943). Due to the presence of two small tubercles between coxae 3 of the ♂ and an attenuated tip of the solenophore, the new species is similar to *M. perfidum*, but the latter species is larger (17-18 mm long and 1.9-2.0 mm wide versus 12 and 1.3 mm), and their gonopods are very different as well.

IDENTIFICATION KEYS

KEY TO TRIBES AND GENERA OF PARADOXOSOMATIDAE OCCURRING IN PARAGUAY AND ADJACENT AREAS

- 1 Paraterga strongly developed, wing-like. (Introduced, normally synanthropic species) ..... 2
- Paraterga poorly developed to missing (Figs 1, 10, 18, 26, 33) (Tribe Catharosomatini, autochthonous species) ..... 4
- 2 Metaterga densely papillate and setose; a bituberculate process between coxae 4 of ♂; femora 4-7 of ♂ each with a ventro-parabasal knob; gonopod femorite stout, solenophore with a large basal prong ventrally ..... Tribe Sulciferini: *Chondromorpha* (*C. xanthotricha*)
- Metaterga not papillate, at most poorly setose; sternum between coxae 4 of ♂ without process; legs of ♂ without such femoral tubercles; gonofemorite not so stout, almost as long as to longer than solenophore ..... 3
- 3 Caudal corners of paraterga surpassing rear tergal contour only on caudalmost segments (16-19); gonofemorite relatively short, distinctly broadened distally; solenophore bifid, at base with a long apical process as well as a prong and a lobe ventrally . . . Tribe Sulciferini: *Oxidus* (*O. gracilis*)
- Caudal corners of paraterga surpassing rear tergal contour on all body segments; gonopod telopodite very slender and simple, rod-shaped; gonofemorite slightly longer than solenophore, latter without outgrowths at base but with a minute lobule at tip ..... Tribe Orthomorpha: *Orthomorpha* (*O. coarctata*)

- 4 Gonopod devoid of a solenophore, solenomere free . . . . . 5  
 - Gonopod with a solenophore sheathing and supporting a flagelliform solenomere . . . . . 9
- 5 Gonopod telopodite extremely simple, subfalcate to subcircular, devoid of any outgrowths at base of a subflagelliform solenomere . . . *Gonodrepanum*  
 - Gonopod telopodite more complex, with 1–2 processes or dilatations in femoral or postfemoral region . . . . . 6
- 6 Gonofemorite with a large, medial, lobuliform dilatation; solenomere with a small tooth near tip . . . . . *Mogyella (M. nana)*  
 - Gonofemorite without a large dilatation but sometimes with a tooth distally or parabasally; 1-2 dilatations or processes at base of solenomere, latter sometimes stout and thick . . . . . 7
- 7 Body small, 0.7 mm wide. Gonopod telopodite subfalcate, much like in *Gonodrepanum*; femorite with a small ventro-parabasal tooth; a small but evident, elongated, subtriangular dilatation/lobe fused ventrally at base with a flagelliform solenomere . . . . . *Pseudogonodrepanum (P. scitum)*  
 - Body medium-sized, >1.0 mm wide. Gonopod telopodite mostly suberect, usually with two independent teeth/outgrowths at base of solenomere . . . . . 8
- 8 Entire gonopod telopodite suberect, with an evident process at base of a rather thick, sometimes bifid solenomere; a setose, linguiform, sternal process between coxae 4 of ♂ . . . . . *Habrodesmoides*  
 - Only gonopod femorite elongated and suberect; solenomere subflagelliform and unciform, acuminate, at base with two relatively small teeth/outgrowths; sternal process between coxae 4 of ♂ either missing or represented by two paramedian knobs . . . . . *Ologonosoma*
- 9 Solenophore simple, subflagelliform, acuminate, supporting a similarly flagelliform solenomere . . . . . 10  
 - Solenophore complex, sometimes with a process or lobe at base, usually consisting of several more or less folded lobes/laminae, almost entirely sheathing a flagelliform solenomere . . . . . 11
- 10 Body width 0.7 mm. Prefemoral (setose) part of gonopod much shorter than acropodite; femorite with a conspicuous lamella on medial side; both solenophore and solenomere somewhat reduced, about half as long as femorite . . . . . *Mogyosoma (M. hamatum)*  
 - Body width 1.1-1.5 mm. Prefemoral portion of gonopod elongated, nearly as long as acropodite; femorite without a lobe on medial side; both solenophore and solenomere longer than femorite . . . . . *Gonodrepanoides (G. travassosi)*
- 11 Solenophore relatively simple but with a large lateral branch/process at base . . . . . *Promestosoma (P. boggianii)*  
 - Solenophore more complex, usually consisting of several lobes but devoid of a large lateral branch at base . . . . . 12
- 12 Sternal cones usually present (Figs 4 & 15); each coxa 2 of ♂ with a strong distoventral process carrying a gonopore (Figs 1 & 14); tibiae of



- ♂ usually conspicuously inflated (Figs 5 & 16). Prefemoral (densely setose) portion of gonopod hypertrophied, about as long as femorite . . . . . *Catharosoma*
- Sternal cones usually absent; normally each coxa 2 of ♂ with a small cone carrying a gonopore; tibiae of ♂ not inflated. Prefemoral portion of gonopod normal, shorter than femorite . . . . . 13
- 13 Tarsal brushes often absent even in ♂; sternite between coxa 3 of ♂ with a conspicuous comb- or tongue-shaped structure (Fig. 20); sternite between coxae 5 of ♂ with a particularly large process directed anteroventrally and covering a boss or protuberance if any between coxae 4 . . . . . *Broelemannopus*
- Tarsal brushes in ♂ mostly present; sternite between coxa 3 of ♂ usually without protuberances; a particularly large process directed anteroventrally and placed between coxae 4, not 5, of ♂ . . . . . *Mestosoma*

KEY TO *BROELEMANNOPUS* SPECIES OF PARAGUAY AND ADJACENT AREAS

- 1 Body of adult < 10 mm long and ≤ 1.0 mm wide; epiproct topped with a prominent claw-shaped uncus directed slightly dorsad (Fig. 19); cones absent at least between front coxae of postgonopodial sterna . . . . . 2
- Body ≥ 14 mm long and ≥ 1.6 mm wide; epiproct without central uncus at tip, latter usually bifid; sternal cones in ♂ present between both pairs of legs of each segment; Brazil . . . . . 3
- 2 Lobe between coxae 4 and 5 of ♂ linguiform, entire (Fig. 20); sternal cones on midbody segments of ♂ totally absent (Fig. 21); solenophore lobe **p** small (Figs 23–25); Paraguay . . . . . *B. minutus*
- Lobe between coxae 4 and 5 of ♂ divided distally; sternal cones in ♂ present between posterior coxae of segments 8–18; solenophore lobe **p** large; São Paulo State, Brazil . . . . . *B. ibitiensis*
- 3 Body 1.6-2.2 mm (♂) or 1.6-2.4 mm wide (♀). Paraterga traceable as low arcuated sulci on segments 2-4, on following segments only as slight impressions visible near caudal margin; pleurosternal carinae traceable until segment 14 . . . . . *B. pirassunungensis*
- Body 2.3-3.3 mm wide (♂, ♀). Each paratergite traceable as a low arcuated crest at least on segment 2; pleurosternal carinae visible until segment 15 . . . . . 4
- 4 Sternal lobe between coxae 3 of ♂ comb-shaped, entire distally; coxae 2-6 of ♂ each with a distoventral coniform process; central protuberance between coxae 7 of ♂ absent; distal end of solenophore not divided . . . . . *B. escaramucensis*
- Sternal lobe between coxae 3 of ♂ linguiform, deeply incised distally; only coxae 2 and 3 of ♂ each with a coniform process; central protuberance between coxae 7 of ♂ present; distal end of solenophore deeply divided into two large lobes, **p** being one of these . . . . . *B. glabratus*

KEY TO *CATHAROSOMA* SPECIES

- 1 Sternum between coxae 6 of ♂ with a single, undivided process or swelling . . . . . 2
- Sternum between coxae 6 of ♂ either with a deeply divided process or with two distinct paramedian processes, or with two paramedian knobs with bunches of long setae . . . . . 5
- 2 Hypoproct tip unciform; gonopod femorite with a prominent, subtriangular, distal lobe . . . . . *C. digitale*
- Hypoproct tip straight; gonofemorite without a prominent, subtriangular, distal lobe . . . . . 3
- 3 Body width about 2.2 mm; no sternal modifications except pilosity between coxae 5 of ♂; tip of solenophore simple, like a broad and subacuminate lobe . . . . . *C. mixtum*
- Body width 3.0-3.2 mm; a swelling and/or a paramedian pair of knobs between coxae 5 of ♂; tip of solenophore more complex . . . . . 4
- 4 Paraterga 2 like swellings, paraterga 3 and 4 sulciform; light subtriangular spots on posterior parts of proterga and on anterior parts of metaterga against a dark background; apical piece of solenophore short, acuminate . . . . . *C. peraccae*
- Paraterga 2-4 like low crests; background coloration pale yellowish with a wide castaneous axial stripe; apex of solenophore very broad and of rather irregular shape . . . . . *C. mesorpinum*
- 5 Even paraterga 2 expressed as sulci; no sternal modifications except pilosity between coxae 5 of ♂ . . . . . *C. myrmekurum*
- Crest-like paraterga present at least on segment 2 (Figs 1 & 10), often ridge/crest-like even on segments 2-4; sternal modifications present between coxae 5 of ♂ . . . . . 6
- 6 Paraterga 2-4 distinctly crest-like, onward sulciform on segments 5, 7, 9 and 10; a distinct bilobed process present between coxae 3 of ♂ *C. palmatum*
- Paraterga even more poorly developed, totally untraceable on segments behind 4<sup>th</sup> . . . . . 7
- 7 Body about 12 mm long and 1.3 mm wide; coxae 2 of ♂ produced distally into a small mammiform process; gonofemorite with a medio-parabasal digitiform process . . . . . *C. curitibense*
- Body width ≥ 1.7 mm; coxae 2 of ♂ usually produced into a more or less prominent process (Fig. 14); gonofemorite devoid of such a process . . . . . 8
- 8 Hypoproct unciform, its tip directed ventrad . . . . . 9
- Hypoproct tip straight . . . . . 12
- 9 Dorsum rather dark, red-brown, with two yellowish paramedian stripes; pleurosternal carinae visible only until segment 15 . . . . . *C. taeniatum*
- Dorsum pale but with two dark, brownish paramedian stripes; pleurosternal carinae visible at least until segment 16 . . . . . 10
- 10 Body of ♂ 1.9-2.1 mm wide; a large and deeply incised process present between coxae 6 of ♂ (Fig. 3) . . . . . *C. bilineatum*

- Body width  $\geq 2.6$  mm; only a pair of small paramedian knobs between coxae 6 of  $\delta$  . . . . . 11
- 11 Apical papillae on epiproct acuminate, elongate and directed distodorsad; gonofemorite strongly broadened distad . . . . . *C. mesoxanthum*
- Apical papillae on epiproct small, simple, inconspicuous; gonofemorite slender . . . . . *C. intermedium*
- 12 A paramedian pair of low setigerous crests present between coxae 3 of  $\delta$ ; gonopod telopodite elongate and circular (Fig. 17) . . . . . *C. mahnerti*
- At most a paramedian pair of bunches of setae present between coxae 3 of  $\delta$ ; gonopod telopodite falcate and stout . . . . . 13
- 13 A single protuberance between coxae 5 of  $\delta$  and a paramedian pair of conical processes between coxae 6 of  $\delta$  . . . . . *C. palustre*
- Two setigerous knobs on a swelling between coxae 5 of  $\delta$  and either a swelling or a paramedian pair of spinules between coxae 6 of  $\delta$  . . . . . 14
- 14 Body width 2.0-2.3 ( $\delta$ ) to 2.5 mm ( $\text{♀}$ ); lobe **p** of solenophore anchoriform and bifid . . . . . *C. paraguayense*
- Body width 2.6 mm ( $\delta$ ); tip of lobe **p** of solenophore blunt, devoid of teeth . . . . . *C. hoffmani*

KEY TO *GONODREPANUM* SPECIES

- 1 Coloration of adults normally castaneous brown with a wide, uninterrupted, axial, contrastingly creamy stripe; Rio de Janeiro, Brazil . . . . . 2
- Coloration uniformly castaneous to black, usually devoid of a contrastingly pallid stripe, or axial stripe/line thin and interrupted; Argentina and/or Brazil . . . . . 3
- 2 Smaller, only known from  $\text{♀}$ : 16-18 mm long and 1.8-2.0 mm wide; clear sulci in place of paraterga 2-4 . . . . . *G. flavolineatum*
- $\text{♀}$  18-21 mm long and 2.2-2.4 mm wide,  $\delta$  15-16 mm long and 1.5-1.6 mm wide; paraterga on segment 2 like crests, on segments 3 and 4 like clear sulci, on following segments like striae; paramedian pairs of setigerous protuberances present between coxae 3-5 of  $\delta$  . . . . . *G. torresae*
- 3 Body particularly slender:  $\delta$  20 mm long and 1.2 mm wide. Dorsum and sides uniformly blackish; paraterga 2-4 crest-like, on following segments sulciform; sternal cones absent; Brazil and Argentina . . . . . *G. drepanephoron*
- Body neither so long ( $\leq 14$  mm even in  $\text{♀}$ ) nor so slender. Coloration of adults usually castaneous, sometimes yellowish; paraterga represented by sulci at most; sternal cones present; Brazil . . . . . 4
- 4 Epiproct topped with two long, claw-shaped, diverging unci directed dorsocaudad; a pale axial stripe/line absent . . . . . 5
- Epiproct without such unci; a pale, axial, interrupted stripe/line usually present . . . . . 6
- 5 Body 12-14 mm long and 1.3-1.7 mm wide; a small ventral tubercle present only on femora 3 and 4 of  $\delta$ ; sternal protuberance between coxae

- 3 of ♂ bifid, sterna between coxae 4 and 5 devoid of protuberances; solenomere subcircular . . . . . *G. grajahuense*
- Body 9-12 mm long and 1.0-1.3 mm wide; a distoventral tubercle present/traceable on femora 3-9 of ♂; median sternal protuberances present between coxae 3-5 of ♂; solenomere regularly and gently subfalcate . . . . . *G. furcatum*
- 6 Body about 14 mm long and 1.3-1.5 mm wide. Metaternal sulci absent; femora of ♂ not modified; a large median process with two knobs behind and between coxae 4 of ♂; solenomere relatively short and suberect; Santa Catarina, Brazil . . . . . *G. levisetum*  
(*G. levisetum* var. *coniferum* seems to only represent a colour form distinguished by a yellowish body devoid of a pattern)
- Body 11-12.5 mm long and 1.1 mm wide. Metaternal sulci light but present; a pair of diverging processes between coxae 5 of ♂; solenomere relatively long, subcircular; Rio de Janeiro, Brazil . . . . . *G. falciferum*

KEY TO *HABRODESMOIDES* SPECIES OF PARAGUAY AND ADJACENT AREAS

- 1 Paraterga replaced by a low arcuated ridge on segment 2, by sulci on segments 3 and 4; pleurosternal carinae traceable until segment 18; a small protuberance present between coxae 5 of ♂; solenomere retrorse, with a slender, subfalcate, simple process at base . . . . . *H. costalimai*
- Segments 2-18 with only slight sulci/striae in place of paraterga; pleurosternal carinae present on segments 2-7; sternite between coxae 5 of ♂ devoid of a protuberance; solenomere directed distoventrad, process at its base massive, stout and branched . . . . . *H. perturbans*

KEY TO *MESTOSOMA* SPECIES OF PARAGUAY AND ADJACENT AREAS

- 1 Sterna between coxae (3)4-6(7) of ♂ each with a more or less distinct median process or protuberance; sternal cones in ♂ absent . . . . . 2
- At least some of these sterna devoid of a protuberance; sternal cones in ♂ often present . . . . . 5
- 2 Body width  $\geq 2.3$  mm; metaternal sulcus present on segments subsequent to 5<sup>th</sup>; no single sternal process between coxae 6 and 7 of ♂ . . . . . 3
- Body width  $\leq 1.5$  mm (♂); metaternal sulci absent; a single, prominent, sternal process between coxae 6 and 7 of ♂; Bolivia . . . . . 4
- 3 Coloration uniformly brownish; sternal processes or protuberances present between coxae 3-6 of ♂; Rio de Janeiro, Brazil . . . . . *M. carioca*
- With a wide pale axial stripe against a dark olive-brown background; sternal process present between coxae 4 of ♂, only protuberances or swellings between coxae 5 and 6 in ♂; Bolivia . . . . . *M. schindleri*
- 4 Body width 1.0 mm (♂); colour pattern in adults indistinct, body uniformly yellowish; femora 3-5 of ♂ each with a ventral tubercle . . . *M. alticola*
- Body width about 1.5 mm (♂); a wide, pale, axial stripe against a chocolate-brown background; femora in ♂ apparently without ventral tubercles . . . . . *M. boliviae*



- 5 Sterna of segment 6 in ♂ with a pair of processes at anterior border, sterna of segment 5 of ♂ devoid of processes; neither tibial nor tarsal brushes present . . . . . *M. differens*
- Sterna of segment 6 in ♂ without processes, those of segment 5 of ♂ with or without processes; tibial and tarsal brushes in ♂ normally present . . . 6
- 6 Colour pattern relatively distinct, usually entire dorsum or axial stripe pale to yellowish, sometimes this stripe divided into two paramedian stripes or broken into series of spots, more or less strongly contrasting with a dark, normally brown background coloration of the sides . . . . . 7
- Colour pattern indistinct, normally dorsum and sides uniformly brown . . . 14
- 7 Sternal process between coxae 4 of ♂ present, conspicuous . . . . . 8
- Sternal process between coxae 4 of ♂ absent to very small . . . . . 10
- 8 Body width < 2.0 mm. Dorsum with axial stripe(s), background coloration brown; gonofemurite not very broad, solenophore evidently longer than 1/2 femurite . . . . . 9
- Body width ≥ 2.0 mm. Dorsum with an axial series of yellowish spots, background coloration dark (red-)brown to black; gonofemurite conspicuously broadened, solenophore scarcely half as long as femurite; Paraguay . . . . . 10
- 9 Dorsum with two yellowish paramedian stripes; tibial and tarsal brushes in ♂ present; a bilobate process present between coxae 4 of ♂; Paraguay . . . . . *M. vittatum*
- Dorsum with two series of paramedian spots; tibial and tarsal brushes in ♂ absent; a lobe-shaped process present between coxae 4 of ♂; Bolivia . . . . . *M. montanum*
- 10 Solenophore with 2-3 prongs/spines subapically . . . . . 11
- End of solenophore subtriangular, often rounded . . . . . 12
- 11 Legs uniformly blackish; a pair of paramedian knobs between coxae 3 of ♂; femora 4-7 in ♂ each with a ventral tubercle, each coxa 7 of ♂ with a distoventral process . . . . . *M. tricuspis*
- Legs brown; a process present between coxae 4 of ♂; apparently neither femora nor coxae of ♂ with ventral tubercles/processes . . *M. pseudomorphum*
- 12 Body width about 3.0 mm. Dorsum with a pale, sometimes yellowish axial stripe; solenophore strongly curved proximad, its end almost in contact with base of femurite . . . . . *M. salvadorii*
- Body width about 2.0 mm. Dorsum with an axial series of conspicuous yellowish spots; solenophore not so strongly curved . . . . . 13
- 13 Median spots situated on proterga and in anterior parts of metaterga; solenophore in medial view almost twice as slender as distofemoral part . . . . . *M. camerani*
- Median spots lying only in middle of metaterga; solenophore in medial view nearly as broad as distofemoral part . . . . . *M. kalliston*
- 14 A single process present between coxae 4 of ♂ . . . . . 15
- Either two cones/tubercles or nothing between coxae 4 in ♂ . . . . . 17
- 15 Body width about 2.0 mm. Sternal process between coxae 4 of ♂ short and subquadrate; solenophore bifid apically . . . . . *M. balzanii*

- Body width 1.3–1.8 mm. Shape of sternal process between coxae 4 in ♂ and of solenophore different . . . . . 16
- 16 Metatergal sulci distinct on segment 5 and following segments; sternal process between coxae 4 of ♂ short and conical; gonofemorite much broader than solenophore . . . . . *M. lugubre*
- Metatergal sulci absent; sternal process between coxae 4 of ♂ long and rectangular; gonofemorite considerably slenderer than solenophore *M. borellii*
- 17 Solenophore base conspicuously constricted (Figs 30–32) . . . . . *M. simplex*
- Solenophore base broader . . . . . 18
- 18 Body length about 12 mm, width 1.3 mm. Metatergal sulcus visible also on segment 18; pleurosternal carinae present until segment 17; a distoventral tubercle present on femora 4–12 of ♂, and a process on coxae 9 of ♂ (Fig. 38); a characteristic process (**m**) at base of solenophore, tip of solenophore pointed (Figs 39–42) . . . . . *M. crassipes*
- Body length at least 17 mm, width 1.8 mm. Metatergal sulci either absent or at most traceable only until segment 17; distofemoral tubercles present until leg 10 of ♂ at most; coxae 9 of ♂ normal; no process at base of solenophore, tip of solenophore more or less rounded . . . . . 19
- 19 Body length 30–34 mm, width 3.8–4.2 mm; tip of solenophore very broadly subtruncate . . . . . *M. truncatum*
- Body length < 29 mm, width ≤ 3.5 mm; tip of solenophore not subtruncate . 20
- 20 Faint sternal cones traceable between coxae 3 and behind segment 7 of ♂; distoventral tubercles present only on femora 9 and 10 of ♂ . . *M. perfidum*
- Noteworthy sternal modifications absent; distoventral tubercles usually present only until femora 7 of ♂ . . . . . 21
- 21 Tip of solenophore bilobate, rather deeply emarginate/notched in the middle, forming more or less equal, rounded lobes . . . . . 22
- Tip of solenophore different . . . . . 23
- 22 Coloration blackish, legs red-brown; both lobes of solenophore tip subequal; Bolivia . . . . . *M. derelictum*
- Coloration dark brown, legs light brown; proximal lobe of solenophore tip somewhat smaller than distal one; Paraguay . . . . . *M. pulvillatum*
- 23 Tip of solenophore subacuminate, narrowly rounded; Bolivia . . . *M. luctuosum*
- Tip of solenophore broadly rounded; Brazil and/or Paraguay . . . . . 4
- 24 Body coloration dark, legs and venter contrastingly pale; pleurosternal carinae traceable until segment 15; a distoventral tubercle present only on femora 7 of ♂; ventral brushes on tibiae of ♂ absent . . . . . *M. bicolor*
- Body coloration brown, legs and venter only slightly paler than remaining body; pleurosternal carinae traceable until segment 16; distoventral tubercles present on femora 4–7 of ♂; ventral brushes present both on tibiae and tarsi in ♂ . . . . . *M. femorale*

KEY TO *OLOGONOSOMA* SPECIES

- 1 Sternal process between coxae 4 of ♂ missing; solenomere retrorse; Brazil (Paraná) . . . . . *O. iguassuense*

- Sternal process between coxae 4 of ♂ represented by two paramedian knobs; solenomere directed distoventrad; Paraguay . . . . . *O. sanctum*

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## REFERENCES

- ATTEMS, C. 1898. System der Polydesmiden. I. Theil. *Denkschriften der mathematisch-naturwissenschaftlichen Classe der Kaiserlichen Akademie der Wissenschaften* 67: 221-482.
- ATTEMS, C. 1899. System der Polydesmiden. II. Theil. *Denkschriften der mathematisch-naturwissenschaftlichen Classe der Kaiserlichen Akademie der Wissenschaften* 68: 251-436.
- ATTEMS, C. 1901. Neue Polydesmiden des Hamburger Museums. *Mitteilungen aus dem Naturhistorischen Museum Hamburg* 18: 85-107.
- ATTEMS, C. 1914. Die indo-australischen Myriopoden. *Archiv für Naturgeschichte* 80: 1-398.
- ATTEMS, C. 1931. Die Familie Leptodesmidae und andere Polydesmiden. *Zoologica (Stuttgart)* 79: 1-149.
- ATTEMS, C. 1937. Myriopoda 3. Polydesmoidea I. Fam. Strongylosomidae. *Das Tierreich* 68: i-xxii, 1-300.
- ATTEMS, C. 1943. Myriopoden von Brasilien, gesammelt von E. Bresslau in den Jahren 1913/14. *Senckenbergiana* 26: 434-458.
- BRÖLEMANN, H. W. 1902a. Myriapodes du Musée de São Paulo. *Revista do Museu Paulista* (1901) 5: 35-236.
- BRÖLEMANN, H. W. 1902b. Myriapodes recuillis par M. E. Gounelle au Brésil. *Annales de la Société entomologique de France* 71: 649-694.
- BRÖLEMANN, H. W. 1929. Myriapodes recueillis au Brésil par M. le Professeur Gaullery, membre de l'Institut. *Mémoires de la Société zoologique de France* 29: 1-37.
- CARL, J. 1902. Exotische Polydesmiden. *Revue suisse de Zoologie* 10: 563-679.
- CHAMBERLIN, R. V. 1957. The Diplopoda of the Lund University and California Academy of Sciences expeditions. Reports of the Lund University Chile Expedition 1948-1949, No. 30. *Lunds Universitets Årsskrift* (N. F. 2) 53 (8): 1-44.
- GOLOVATCH, S. I. 1992. Review of the Neotropical millipede genus *Onciurosoma* Silvestri, 1932, with the description of three new species from near Manaus, Central Amazonia, Brazil (Diplopoda, Polydesmida, Paradoxosomatidae). *Amazoniana* 12 (2): 227-237.
- GOLOVATCH, S. I., HOFFMAN, R.L., MÁRMOL, A. & ADIS, J. 2003. A new, apparently arboricolous species of the millipede genus *Mestosoma* Silvestri, 1897 from near Iquitos, Peruvian Amazonia (Diplopoda: Polydesmida: Paradoxosomatidae). *Amazoniana* 17 (3/4): 343-348.
- HOFFMAN, R. L. 1977. The milliped genus *Mestosoma* in Costa Rica (Polydesmida: Paradoxosomatidae). *Studies on the Neotropical Fauna and Environment* 12: 207-215.
- HOFFMAN, R. L. 1980. Classification of the Diplopoda. *Muséum d'histoire naturelle de Genève* (1979), 237 pp.
- HOFFMAN, R. L. 1999. Checklist of the millipeds of North and Middle America. *Virginia Museum of Natural History Special Publication*, Number 8, Martinsville, 584 pp.
- JEEKEL, C. A. W. 1963. Diplopoda of Guiana (1-5). In: GEUSKES, D. C. & WAGENAAR HUMMELINCK, P. (eds). *Studies on the fauna of Suriname and other Guyanas* 4: 1-157.
- JEEKEL, C. A. W. 1965. A revision of the South American Paradoxosomatidae in the Museo Civico di Storia Naturale di Genova (Diplopoda, Polydesmida). *Annali del Museo Civico di Storia Naturale di Genova* 75: 99-125.

- JEEKEL, C. A. W. 1968. On the classification and geographical distribution of the family Paradoxosomatidae (Diplopoda, Polydesmida). *Academisch Proefschrift, Rotterdam*, 162 pp.
- JEEKEL, C. A. W. 2002. Paradoxosomatidae from Venezuela, with the description of a new species (Diplopoda, Polydesmida). *Myriapod Memoranda* 5: 40-51.
- KRAUS, O. 1956. Über neotropische Strongylosomatidae (Diplopoda). *Senckenbergiana biologica* 37 (5/6): 403-419.
- MAURIÉS, J.-P. 1998. Diplopoda (pp. 475-484). In: MORRONE, J. J. & COSCARÓN, S. (eds). Biodiversidad de artrópodos argentinos: Una perspectiva biotaxonomica. *Sur, La Plata*, 599 pp.
- SCHUBART, O. 1943. Espécies novas das famílias Strongylosomidae e Leptodesmidae da ordem Proterospermophora do interior dos estados de São Paulo e de Mato-Grosso. *Papéis Avulsos do Departamento de Zoologia São Paulo* 3 (8): 129-163.
- SCHUBART, O. 1944. Os diplopodos de Pirassununga. *Acta Zoologica Lilloana* 2: 321-440.
- SCHUBART, O. 1945a. Diplopodos de Monte Alegre (Município de Amparo, Est. de São Paulo). *Papéis Avulsos do Departamento de Zoologia São Paulo* 6 (23): 283-320.
- SCHUBART, O. 1945b. Os Proterospermophora do Distrito Federal (Myriapoda, Diplopoda). *Arquivos do Museu Nacional Rio de Janeiro* 38: 1-156.
- SCHUBART, O. 1952. Diplopoda de Pirassununga IV. Adenda à fauna regional. *Dusenya* 3 (6): 403-420.
- SCHUBART, O. 1953. Sobre os Diplopoda dos estados do Paraná e Santa Catarina. *Arquivos do Museu Paranaense Curitiba* 10 (3): 77-140.
- SILVESTRI, F. 1895a. Chilopodi e diplopodi raccolti dal Capitano G. Bove e dal Prof. L. Balzan nell'America meridionale. *Annali del Museo Civico di Storia Naturale di Genova*, Serie 2, 14 (34): 764-783.
- SILVESTRI, F. 1895b. Chilopodi e diplopodi. Viaggio del dottor Alfredo Borelli nella Repubblica Argentina e nel Paraguay. XIV. *Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Università di Torino* 10 (203): 1-12.
- SILVESTRI, F. 1897. Chilopodi e diplopodi. Viaggio del Dott. Alfredo Borelli nel Chaco boliviano e nella Repubblica Argentina. IV. *Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Università di Torino* 12 (283): 1-11.
- SILVESTRI, F. 1898. Descrizione di alcuni nuovi diplopodi raccolti nell'Alto Paraguay dal Cav. Guido Boggiani. *Annali del Museo Civico di Storia Naturale di Genova*, Serie 2, 18 (38): 671-675.
- SILVESTRI, F. 1902. Diplopodi. Viaggio del Dr. A. Borelli nel Matto Grosso. VII. *Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Università di Torino* 17 (432): 1-25.
- SILVESTRI, F. 1905. Myriapoda. *Zoologische Jahrbücher, Supplementband* 6. *Fauna Chilensis* 3: 715-772.
- VERHOEFF, K. W. 1938. Über Diplopoden des Zoologischen Museums in München. *Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere* 71: 1-54.